

# TECHNICAL PROGRESS REPORT ON THE GLOBAL DATA PROCESSING SYSTEM 2002

## OMSZ - HUNGARIAN METEOROLOGICAL SERVICE

### 1. SUMMARY OF HIGHLIGHTS

At the beginning of 2002 our new IBM Regatta server was installed at the OMSZ - Hungarian Meteorological Service. The main characteristics of the new machine are as follows: 32 processors (peak performance: 5,2 Gflop/s each processor), 32 Gbyte internal memory and 364 Gbyte disk space. The old mainframe computer of the Service, the SGI Origin 2000 machine was also upgraded having stronger processors (altogether 16 processors). The ALADIN limited area model is running on the IBM machine and the nowcasting programme package is on the SGI machine. Thanks to the increased computer power the domain of the ALADIN/HU local version of the ALADIN model had been significantly extended together with a resolution increase.

### 2. EQUIPMENTS IN USE AT THE CENTRE

IBM Regatta p690 server with 32 processors (1,3 GHz processors), SGI Origin 2000 machine with 16 processors (500 MHz processors), HP L2000 cluster server with 4 CPU by computers, HP K250, as well as HP D280 servers and HP B180, HP J210, HP C200, DEC and SUN workstations, EMC Clariion FC4700 disk storage system (2 Tbyte native capacity), several LINUX computers (used for: Message Switching System, FTP, mail server, and other special meteorological purposes), CISCO routers and switches.

### 3. DATA AND PRODUCTS FROM GTS IN USE

The daily statistics of raw information:

SYNOP: 00/06/12/18 UTC      1900

TEMP: 00/12 UTC              100  
      06/18 UTC              30

The daily statistics of products:

GRID (EGRR): 00/12 UTC        500  
(EDZW): 00/12 UTC            70

GRIB (EDZW): 00/12 UTC        650

FAX (EDZW): 00/12 UTC        75  
              06 UTC            5  
              18 UTC            30

#### 4. DATA INPUT SYSTEM

Automated

#### 5. QUALITY CONTROL SYSTEM

Horizontal consistency check (for SYNOP messages) and hydrostatic vertical quality control (TEMP messages).

#### 6. MONITORING OF THE OBSERVING SYSTEM

Surface and upper-air observations are monitored on the national level.

#### 7. FORECASTING SYSTEM

The ALADIN limited area model (ALADIN/HU) is operationally launched twice a day providing 48 hour forecasts.

##### 7.1 SYSTEM RUN SCHEDULE

The ALADIN short range forecasting model is launched on the IBM p690 Regatta machine, the data processing and visualisation are made on HP servers and workstations and also on linux PC-s.

##### 7.2 MEDIUM-RANGE FORECASTING SYSTEM (4-10 DAYS)

There isn't any own medium range forecasting model.

##### 7.2.4 OPERATIONAL TECHNIQUES FOR APPLICATION OF NWP PRODUCTS

10 day forecasts of deterministic model and ensemble prediction system of ECMWF is operationally used. Meteorological fields are displayed on workstations by the HAWK (Hungarian Advanced Workstation) visualisation software. Automatic forecast generation is carried out based on the outputs of the ECMWF models until 6 days. The Kalman filter procedure is operational for the 2m temperature forecasts of the ECMWF model (see also ALADIN/HU model).

##### 7.3 SHORT-RANGE FORECASTING SYSTEM (0-72 HRS)

##### 7.3.1 DATA ASSIMILATION, OBJECTIVE ANALYSIS AND INITIALIZATION

The operational numerical weather prediction model ALADIN/HU is applied in dynamical adaptation mode, i.e. the initial and lateral boundary conditions of the model are gained by

interpolation from the larger scale ARPEGE global model. The model integration is preceded by digital filter initialisation.

There is also an optimal interpolation procedure (executed on an hourly basis), which serves as input for the nowcasting-type applications and procedures (so it is not used as initial condition for any NWP model).

Intensive developments were devoted to the application of the three-dimensional variational (3D-VAR) data assimilation scheme for the ALADIN model. At the moment the 3D-VAR model version is running in parallel suite in order to prepare the operational introduction.

### 7.3.2 MODEL

The operational ALADIN/HU limited area NWP model is a version of the ALADIN model for the region over Europe. The main characteristics of the ALADIN model are as follows:

- Hydrostatic primitive equations;
- The equations are solved using the spectral method having elliptical truncation of bi-Fourier series;
- Hybrid vertical co-ordinates;
- Two-time level semi-lagrangian advection scheme;
- Semi-implicit timestepping;
- 4<sup>th</sup> order horizontal diffusion,
- Davies-Kallberg coupling (relaxation) scheme;
- The physical parameterisation package (simple radiation scheme, Bougeault deep convection scheme etc.) is rather the same than it is for the ARPEGE French global model.

The main characteristics of the ALADIN/HU application are the following:

- Domain covering continental Europe;
- Integration twice a day (at 00 and 12 UTC) for 48 hours;
- 432\*384 points in horizontal and 37 vertical model levels,
- Approximately 6,5 km of horizontal resolution;
- Coupling by the ARPEGE global model every 3 hours;
- Post-processed products every hour for the first 36 hours and 3 hourly afterwards on 32 pressure and 9 height levels.

### 7.3.3 NUMERICAL WEATHER PREDICTION PRODUCTS

*Two-dimensional fields:* mean sea level pressure, surface temperature, convective and frontal precipitation (including snow), total cloudiness (including low, medium and high level clouds), surface pressure, snow thickness, 10m wind, 2m temperature and relative humidity, 2m minimum and maximum temperature, pressure and temperature of the ICAO jet, surface pressure tendency, total precipitable water, short wave radiation arriving to the surface.

*Three-dimensional fields:* These fields are obtained on 9 height levels (on 20, 100, 300, 500, 600, 750, 900, 1250, 1500 metres) in the planetary boundary layer and on 32

pressure levels (on 1000, 990, 980, 970, 960, 950, 940, 925, 900, 880, 860, 850, 840, 820, 800, 780, 760, 740, 720, 700, 650, 600, 550, 500, 450, 400, 350, 300, 250, 200, 150, 100 hPa). The variables are as follows: geopotential (only on pressure levels), pressure (only on height levels), temperature, wind field, relative humidity, pseudo-potential temperature, vertical velocity (only on pressure levels), divergence (only on pressure levels), potential temperature (only on pressure levels), potential vorticity (only on pressure levels) and absolute vorticity (only on pressure levels).

#### 7.3.4 OPERATIONAL TECHNIQUES FOR APPLICATION OF NWP PRODUCTS

Automated forecast generation based on the outputs of the ALADIN models giving 48 hours forecasts. Kalman filter statistical adaptation algorithm is operationally running for improving the 2m temperature forecasts of the ALADIN/HU model.

#### 8. VERIFICATIONS OF PROGNOSTIC PRODUCTS

ECMWF, ALADIN/LACE and ALADIN/HU products are verified and compared operationally computing simple statistical measures (bias and RMSE) using all the SYNOP and TEMP observations inside the domain of the ALADIN/HU domain. The verification is performed along the EWGLAM (European Working Group for Limited Area Modelling) standards. The automatically generated forecasts are also verified and compared to the forecasts issued by the forecasters.

#### 9. PLANS FOR THE FUTURE

The main plans are listed below:

- Put into operations the three-dimensional variational (3D-VAR) data assimilation scheme for the ALADIN model.
- Further improvements of the 3D-VAR scheme with special emphasis on new data sources.
- Planning of a new project related to the ensemble prediction system for limited area models.

#### 10. REFERENCES

Horányi, A., I. Ihász, and G. Radnóti, 1996: ARPEGE/ALADIN: A numerical weather prediction model for Central-Europe with the participation of the Hungarian Meteorological Service. *Időjárás*, 100., 277-300.